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SPORT232 User's Guide
Table of Contents

Chapter 1: INTRODUCTION 1

Chapter 2: PARTS AND LOCATIONS 3

Chapter 3: GETTING STARTED 4

Step 1: Connect the SPORT232 Board to a Computer 4
Step 2: Connect the Power Supply 4
Step 3: Configure Computer 5
Step 4: Setting the Analog Channels Attenuation and Gain 5
Input Attenuator 6
Variable Gain 6

Chapter 4: FUNCTIONS 7

Digital Input/Output 8
Interrupt 8
Reading Analog Channels 8
Sampling AD Channels 8
PWM 8
Measuring a Resistor or Capacitor 8
Period Measurement 8
Stepper Motor Control 9

Appendix A: Stepper Motor Connection Diagram

SPORT232 User's Guide
Data Acquisition and Control Board

Chapter 1 INTRODUCTION

The SPORT232 Data Acquisition and Control Board for acquisition and control of both digital and analog signals. The SPORT232 is ready with 11 analog input channels to connect to sensors such as thermocouples, pH probes, photo cells, strain gauges, and piezoelectric sensors for data acquisition applications. 4 channels feature low off-set signal conditioning which allows connection to almost any analog device without having to undergo the time and expense of developing an amplifier for the external device.

The SPORT232 also offers 24 digital I/O that are TTL compatible. Each line can source/sink up to 10mA.

Embedded functions in the on-board WiZ232-A microcontroller enable the SPORT232 to be used for generating a PWM signal; measuring resistance, capacitance and period; and for controlling a stepper motor - in addition to its data acquisition and control capabilities.

Specifications:

Easy to learn and use ASCII commands for reading and writing data through any computer serial port. Needs no previous programming skills or experience.

DB9 female connector for serial port connection.

Cable selection jumpers.

High Speed Serial Port Interface from 9600 to 230400 baud.

24 digital I/O lines, each TTL compatible, can source/sink up to 10 mA.

High Speed Serial Peripheral Interface for driving synchronous devices.

11 Analog Channels with 8 or 12 bit resolution:
- 4 channels with low offset precision signal (1MOhms impedance) conditioning amplifier.
- Three input ranges : 100mV, 2.5 V & 5.0 V.
- 7 additional 10 KOhms input impedance channels, 2.5 V range (no signal conditioning).
- 2.5 V precision voltage reference for A/D converter.

Internal FIFO for reading/storing A/D samples for digital signal processing applications.

Industrial Temperature Grade (optional).

Embedded Functions for measuring :
- resistance (500 ohms to 10 M ohms).
- capacitance (100 pF to 10 uF).
- period (100 us to 100 ms) for applications requiring reading magnetic pick up sensors, frequency to voltage conversion etc. .

TTL Pulse generator with 24 bit counter and variable duty cycle from 15 Hz to 15 KHz.

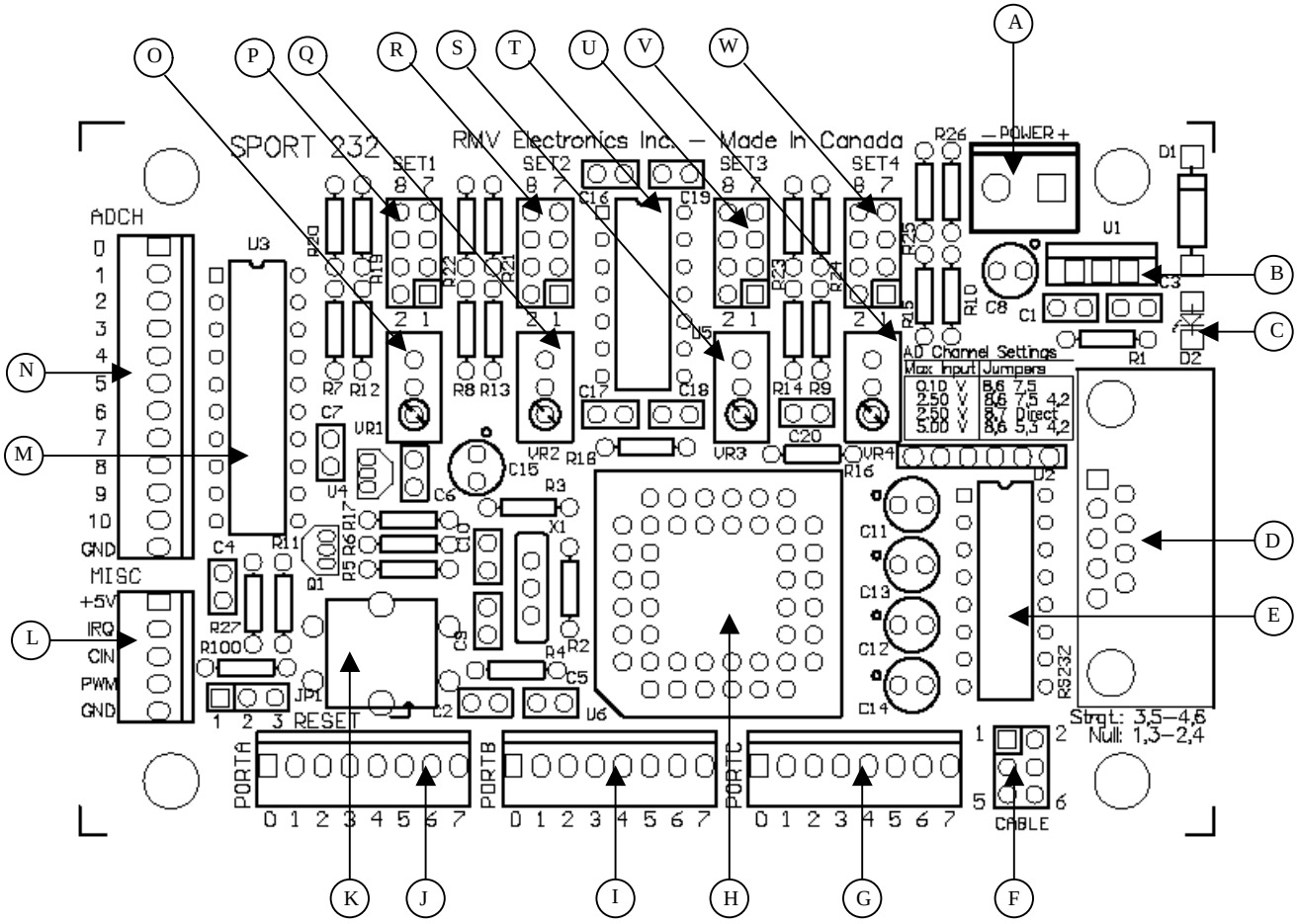
Stepper Motor controller function:

- Step speed from 16 steps/sec up to 8,500 steps/sec.
- Linear acceleration/deceleration capability.
- 24 bit position/stepping register.
- 4 output signals for full/half step modes.

Software:

- 32 bit DLL for Windows 98/NT

Chapter 2 PARTS AND LOCATIONS



A	Power Input	**M**	Analog to Digital Converter
B	Voltage Regulator	**N**	Analog Inputs
C	Power On LED	**O**	Ch0 Gain Adjust
D	RS232 Connector	**P**	Ch0 Gain Selector
E	Serial Port Driver	**Q**	Ch1 Gain Adjust
F	Serial Cable Selector	**R**	Ch1 Gain Selector
G	Port C I/O	**S**	Ch2 Gain Adjust
H	Microcontroller	**T**	Operational Amplifier
I	Port B I/O	**U**	Ch2 Gain Selector
J	Port A I/O	**V**	Ch3 Gain Adjust
K	Reset Button	**W**	Ch3 Gain Selector
L	Misc. Port		

Chapter 3 GETTING STARTED

Step 1: Connect the SPORT232 Board to a Computer

Due to the variety of connectors used from one computer manufacturer to another, the cable is not provided with the SPORT232 board.

Using an off-the-shelf cable:

Connect a DB9 (male) to DB25 (female) serial cable to the DB9 connector on the SPORT 232 board and the RS232 (DB25) connector of your computer. One common off-the-shelf cable which is appropriate for use with the SPORT232 board is a serial port to serial printer (null modem) cable which has DB9 (male) and DB25 (female) connectors.

Using custom cabling:

In order to assemble your own cable, Table 1 shows the proper pin to pin connections and the required connectors.

TABLE 1 - SERIAL CABLE CONNECTIONS

NULL MODEM CABLE		STRAIGHT CABLE	
DB25-FEMALE	DB9-MALE	DB25- FEMALE	DB9- MALE
PIN 7	PIN 5	PIN 7	PIN 5
PIN 3	PIN 2	PIN 3	PIN 3
PIN 2	PIN 3	PIN 2	PIN 2

For a null modem cable (crossed wire configuration): The TX line on the SPORT232 board (DB9) goes to the TX line on the computer (DB25) and the RX line on the board (DB9) goes to the RX line on the computer (DB25). GND on the board goes to digital ground on the computer.

For a straight cable: The RX line on the SPORT232 board goes to the TX line on the computer and the TX line on the board goes to the RX line on the computer. GND on the board goes to digital ground on the computer.

Serial Port Jumper Settings:

The jumper settings for the serial port connection must be set according to the type of cable used. For a straight cable, the serial port jumpers must be set on pins 3, 5 and 4, 6. For a null modem cable, the serial port jumpers must be set on pins 1, 3 and 2, 4.

For modem operation, if a straight cable is used, the jumpers must be set for a null modem cable (1,3 and 2,4). If a null modem cable is used to connect to a modem, the straight cable jumper settings (3,5 and 4,6) must be used.

Step 2: Connect the Power Supply

In order to operate the SPORT232 Board, connect a power supply or battery between 7 to 15 VDC to the Power terminal block (A). This can be provided through a wall AC/DC transformer (300 mA is standard for most applications), a battery (at least 9V), or any other DC power supply.

Caution: Be sure to check the polarity before connecting the power supply. If they are reversed the regulator will burn out.

If you are using an on-board 7805 regulator, make sure it does not heat up. This would indicate a short somewhere in the circuit.

Step 3: Configure Computer or Terminal Emulation Program

The normal procedure for developing specific applications for the SPORT232 is first to develop and test the commands you want to send to the peripheral using a terminal emulation program, such as PROCOMM®, Terminal® for Windows®, MAC240®, etc. Once the program has been outlined, an application code in a higher level language such as C, Pascal, QBASIC, Visual BASIC, etc. can be written for the task(s) to be performed

In this manner, you can operate the SPORT232 board from a custom written program or you can operate it from any commercial communications software.

Make sure that the COM port you select in your program corresponds to the one to which the SPORT232 is connected. Choose 9,600 baud on the terminal. The other parameters are always N,8,1 (no parity, 8 bits and 1 stop bit). The baud rate can be changed later to any standard value between 9600 and 115200 Bauds.

When using a commercial communications software package select 'no CR translation to CR/LF' (Carriage Return/Line Feed). LF is ignored by the ITC232-A but it still takes some time to be sent. Enable the local echo if you are using a communications package.

Important: Make sure the Backspace key on your terminal sends out ASCII(#8), otherwise you will not be able to correct a command without retyping it entirely (in some terminal emulator programs, such as the one included in Windows®, a backspace is generated with a Ctrl key (e.g. under VT-100 terminal emulation, backspace is Ctrl- H)).

While with commercial software packages the CRAB (Bin), CRAD (Dec) or CRAH (Hex) configurations work best, the CRAP (Program) configuration is optimized for controlling the ITC232-A from within your own programs.

When power is applied to the SPORT232 Board, the unit boots up and displays the following message:

```
WiZ232A - RMV Electronics Inc.
>
```

The '>' means that the SPORT232 Board is ready to receive any command you type on your terminal, execute it, and display the data.

Step 4: Setting the Analog Channels Attenuation and Gain

In order to read a voltage using an Analog Input channel, the input attenuation for that channel must be set up. If the channel is to be set for an input signal of 2.5V to 5V, no gain adjustment is needed. However, for all 100mV channel settings, the gain must be adjusted for these channels.

Input Attenuator

The input attenuator scales the analog input according to the voltage reference for each channel as provided by the Analog to Digital Converter (ADC). This prevents the input voltage of the selected input channel from exceeding the dynamic range of the input amplifier. The input attenuator must be set for each individual channel being used. On the SPORT232 the input attenuation may be set for up to four channels (Channels 0 to 3). This is done by setting the jumpers on Set1 for channel 1, Set2 for Channel 2, and so on. The following table, which is also printed on the SPORT232 Board PCB for easy reference, indicates the correct jumper settings for a given dynamic range for a channel.

Dynamic Range	Jumper Settings
0 to 100 mV DC.	8,6 7,5
0 to 2.5 VDC	8,6 7,5 4,2
0 to 2.5 VDC (w/o Op Amp)	8,7 Direct
0 to 5 VDC.	8,6 5,3 4,2

Thus, for example, if input channel 1 has a dynamic range of 0 to 100mVDC, the jumpers on Set1 would be set on pins 8 and 6 for one jumper and 7 and 5 for a second jumper.

Note 1: For a signal range of 0 to 2.5 VDC without the use of the operational amplifier, the only jumper setting required is 8,7. This is useful for situations in which the external sensor already has signal conditioning or in situations in which you do not want to use the SPORT232 Board's on-board signal conditioning. This setting will provide an input impedance of 10K Ohms. The rest of the settings will provide an impedance of 1M Ohms.

Note 2: All voltage readings obtained through the analog input channels do not give true voltage. These readings are relative to the on-board voltage reference which is 2.5V. In order to calculate the reading value in volts (V_r), with a 12 bit ADC, the following formula must be used:

$$V_r = \frac{\text{reading}}{4096} \times 2.5V$$

The resultant voltage figure must then be multiplied by a constant, depending on the dynamic range of the input selected for that particular channel, in order to determine the actual voltage (V_a) for each channel.

Dynamic Range

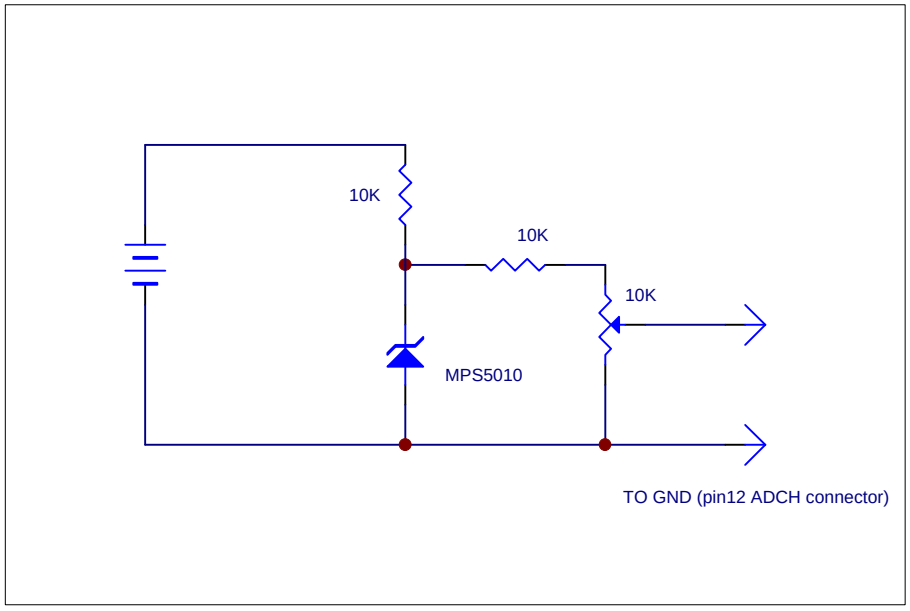
0 to 100mV $\quad \frac{V_r}{25} = V_a$

0 to 2.5V $\quad V_r = V_a$

0 to 5V $\quad V_r \times 2 = V_a$

Variable Gain

The next step is to adjust the variable gain for all 100mV channels using the corresponding potentiometer (G) for the channel to be adjusted. In order to adjust the gain for analog channels set at 100mV a known voltage reference should be used. This voltage reference can be constructed using a reference diode such as an MPS5010 as shown in the following schematic.



For calibrating this reference the procedure is the following:

Step 1: Adjust the voltage reference by using P1 and take a reading at 'A' with a high Z digital voltmeter.
Step 2: Adjust P1 in order to get a reading of 50mV + or - 100 µV.
Step 3: Connect 'A' to the + (positive) terminal of the channel being adjusted

In order to trim the gain for a channel, perform the following procedure:

1. With the terminal emulation program, enable the channel to be adjusted using the GA (Get Analog Channel) command. For example for Channel 0 this command would be GA12;0 'Enter'. For details regarding the use of this command, please refer to the WiZ232 User's Guide.
2. Using the 'Again' (@) command, gets a repetitive reading without having to type the GA command again.
3. Moving the trimmer on the potentiometer in a counterclockwise direction increases the gain and turning the trimmer on the potentiometer in a clockwise direction decreases the gain. For a 50mV value on the input, the reading will be approximately 2048.
4. Repeat this procedure for all analog channels with a 100mV setting remembering to change the connection of the calibration probe to the corresponding channel.

Chapter 4 FUNCTIONS

The SPORT232 Data Acquisition and Control Board features all of the functions embedded in the WiZ232-A micro-controller. For a detailed description of these functions, refer to the WiZ232 User's Guide.

Digital Input/Output

The SPORT232 has 6 ports. One is the RS232 port which links it to the terminal via pins 232TX and 232RX. The other 5 ports can be used in your circuit and they are: PA, PB, PC, PD and PS. PA, PB and PC are general purpose I/O 8 bit ports. These 24 pins can be individually configured as inputs (high impedance) or outputs. In the latter case, pins can be individually addressed since even though the entire port value must be written to a port, the pins remaining in their former state will not change levels at any time. PD is a 5 bit input/output port which shares pins with PS, a synchronous Serial Peripheral Interface (SPI) that can be used to communicate with other chips such as a parallel in/serial out shift register.

Interrupt

In order to signal the occurrence of certain external events, the SPORT232 may send some special characters to the terminal or host computer. One of these characters (L) is sent when a valid interrupt pulse appears on the IRQL input.

Reading Analog Channels

The SPORT232 provides an easy way of reading Analog signals using the on-board Analog to Digital Converter. The command is very simple to use and the user only needs to provide the resolution and the channel to read.

Sampling AD Channels

The SPORT232 provides a simple way of getting samples from an analog signal. Speeds from 20 samples per second up to 2500 samples per second are attainable. This constitutes a Real Time data acquisition feature. Real time sampling is useful for many applications such as Spectrum Analysis using FFT, Digital Filtering of noise, etc. The basic idea is gathering data sampled by the SPORT232 and storing this data for later evaluation on the host computer.

Pulse Width Modulation (PWM)

The SPORT232 has the capability to generate a PWM signal. The frequency and duty cycle of the pulses can be specified from the terminal. The frequency range is 15-15,000 Hz and the duty cycle can be set from 0 to 100% in 1 % intervals.

Measuring a Resistor or Capacitor

The input impedance of port C on the SPORT232 is extremely high. Thus, if an RC network is connected to an input pin as shown in the following figure, then the time constant of the network can be determined by measuring the time to reach a Low to High transition.

Since for a given pin the transition point is constant if VDD is kept constant, relative capacitance and resistance can be measured. Values from one pin cannot be compared to those from another pin because the transition points are not identical.

Period Measurement

Period measurement is done by using the GP (Get Period) function and uses the CIN pin of the WiZ232 controller in order to get a period reading from an external signal.

The SPORT232 includes an on-board amplifier, which allows AC signals with the proper level to drive the CIN input (count in). The minimum signal necessary to drive this amplifier is approximately 200mV rms, while the maximum should not exceed 5V rms. The amplifier acts like a pulse differentiator, which means that at lower frequencies (below 1KHz) the slew rate of the signal might be not enough to drive the trigger level, depending on the wave shape. This is not a problem when driving the input with square wave signals.

Stepper Motor Control

The SPORT232 features a stepper motor controller port (PortC) with all the necessary signals for controlling external drivers, with monophasic, biphasic and half-step stepping modes. Acceleration and deceleration are available for complex motion control. Stepping rates in the range of 16 to 8500 steps/sec are supported.

Control of a stepper motor may be performed using the SPORT232 through the use of both hardware and software. When used for the control of stepper motors, the SPORT232 dedicates PORTC to handle the signals required for this function. Pins PC4 through PC7 are used for stepper motor phase outputs. For additional hardware control, four signals on PORTA: Pulse, Direction, Trigger, and Pause, and a Stop signal on the IRQL (Interrupt pin) are provided. Pulse and Direction are output signals and Trigger, Pause and Stop are input signals used for the control of a stepper motor.

The main command provided for the software control of a stepper motor is the Stepper Configuration Command. The parameters of this command precisely define the motion of the stepper motor. These parameters include: Mode (half step, biphasic, monophasic), Direction (clockwise or counterclockwise), Slew Rate (16 to 8,500 steps/second), Acceleration or Deceleration (0 to 255 steps/second^2) and Initial Rate (16 to 8,500 steps/second).

Other stepper control related commands are also provided for greater functionality. These commands include: SN (get stepper position), SD (disable stepper), SR (reset stepper position register value to 0), SS (stop stepping) and S? (get stepper status).

A schematic in the Appendix shows an example of how to implement an external driver for a 5 or 6 wire unipolar stepper motor and a 4 wire bipolar stepper using the SPORT232.

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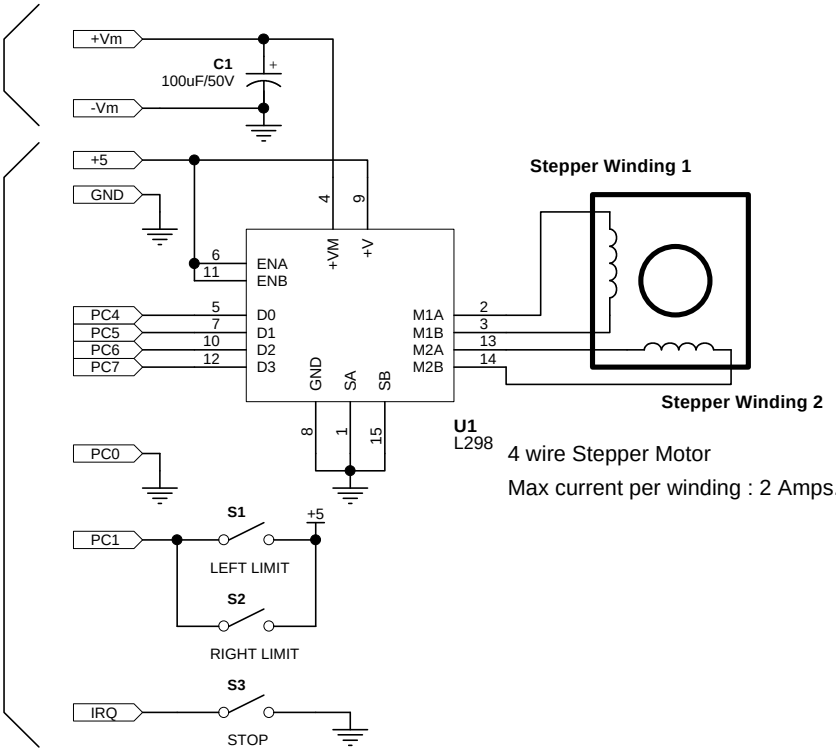
Apendix A - STEPPER MOTOR DRIVING USING THE SPORT 232

Four Wire Stepping Motor IC Driver

Motor Power Supply

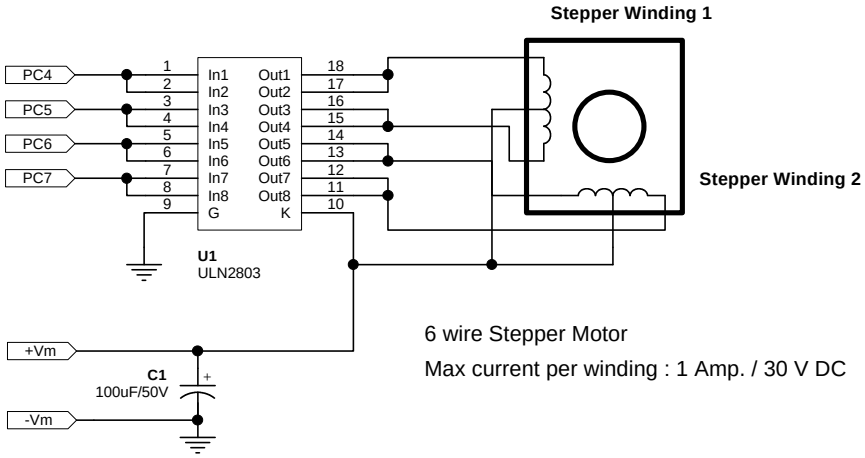
SPORT 232



4 wire Stepper Motor

Max current per winding : 2 Amps. / 48 V DC

Six Wire Stepping Motor IC Driver



6 wire Stepper Motor

Max current per winding : 1 Amp. / 30 V DC